

COMPLIANT

## Low-Voltage Dual SPST Analog Switch

## **DESCRIPTION**

The DG9232/9233 is a single-pole/single-throw monolithic CMOS analog device designed for high performance switching of analog signals. Combining low power, high speed ( $t_{ON}$ : 35 ns,  $t_{OFF}$ : 20 ns), low on-resistance ( $r_{DS(on)}$ : 20  $\Omega$ ) and small physical size, the DG9232/9233 is ideal for portable and battery powered applications requiring high performance and efficient use of board space.

The DG9232/9233 is built on Vishay Siliconix's low voltage BCD-15 process. Minimum ESD protection, per Method 3015.7 is 2000 V. An epitaxial layer prevents latchup. Break-before -make is guaranteed for DG9232/9233.

Each switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

### **BENEFITS**

- Reduced Power Consumption
- Simple Logic Interface
- High Accuracy
- Reduce Board Space

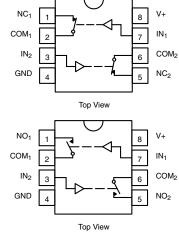
## **FEATURES**

- Low Voltage Operation (+ 2.7 to + 5 V)
- Low On-Resistance  $r_{DS(on)}$ : 20  $\Omega$
- Fast Switching t<sub>ON</sub>: 35 ns, t<sub>OFF</sub>: 20 ns
- Low Leakage I<sub>COM(on)</sub>: 200 pA max
- Low Charge Injection Q<sub>INJ</sub>: 1 pC
- · Low Power Consumption
- TTL/CMOS Compatible
- ESD Protection > 2000 V (Method 3015.7)
- Available in MSOP-8 and SOIC-8

## **APPLICATIONS**

- · Battery Operated Systems
- Portable Test Equipment
- · Sample and Hold Circuits
- · Cellular Phones
- Communication Systems
- · Military Radio
- PBX, PABX Guidance and Control Systems

## **FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION**



TRUTH TABLE - DG9232				
Logic	Switch			
0	ON			
1	OFF			

Logic "0" ≤ 0.8 V Logic "1" ≥ 2.4 V

TRUTH TABLE - DG9233			
Logic	Switch		
0	OFF		
1	ON		

Logic "0" ≤ 0.8 V Logic "1" ≥ 2.4 V

RING INFORMATIO	N	
Temp Range	Package	Part Number
		DG9232DY
		DG9232DY-E3
		DG9232DY-T1
	SOIC-8	DG9232DY-T1-E3
40 to 95 °C		DG9233DY
- 40 to 85 °C		DG9233DY-E3
		DG9233DY-T1
		DG9233DY-T1-E3
	MSOP-8	DG9232DQ-T1-E3
	WISOF-6	DG9233DQ-T1-E3

<sup>\*</sup> Pb containing terminations are not RoHS compliant, exemptions may apply

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ABSOLUTE MAXIMUM RATINGS					
Parameter	Limit	Unit			
Reference V+ to GND		- 0.3 to + 13	V		
IN, COM, NC, NO <sup>a</sup>		- 0.3 to (V+ + 0.3)	V		
Continuous Current (Any terminal)		± 20	mA		
Peak Current (Pulsed at 1 ms, 10 % duty cycle)		± 40	IIIA		
ESD (Method 3015.7)		> 2000	V		
Storage Temperature	D Suffix	- 65 to 125	°C		
Power Dissipation (Packages) <sup>b</sup>	8-Pin Narrow Body SOIC <sup>c</sup>	400	mW		

## Notes:

- a. Signals on NC, NO, or COM or IN exceeding V+ will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- b. All leads welded or soldered to PC Board.
- c. Derate 6.5 mW/°C above 70 °C.

		Test Conditions Otherwise Unless Specified		D Suffix - 40 to 85 °C			
Parameter	Symbol	$V+ = 3 V, \pm 10 \%, V_{IN} = 0.8 V \text{ or } 2.4 V^{e}$	Temp <sup>a</sup>	Min <sup>c</sup>	Typ <sup>b</sup>	Max <sup>c</sup>	Unit
Analog Switch							
Analog Signal Range <sup>d</sup>	V <sub>ANALOG</sub>		Full	0		3	V
Drain-Source On-Resistance	r <sub>DS(on)</sub>	$V_{NO}$ or $V_{NC} = 1.5 \text{ V}, V_{+} = 2.7 \text{ V}$ $I_{COM} = 5 \text{ mA}$	Room Full		30	50 80	
r <sub>DS(on)</sub> Match <sup>d</sup>	$\Delta r_{DS(on)}$	$V_{NO}$ or $V_{NC} = 1.5 \text{ V}$	Room		0.4	2	Ω
r <sub>DS(on)</sub> Flatness <sup>d</sup>	r <sub>DS(on)</sub> Flatness	V <sub>NO</sub> or V <sub>NC</sub> = 1 and 2 V	Room		4	8	
NO or NC Off Leakage Current <sup>g</sup>	I <sub>NO/NC(off)</sub>	$V_{NO}$ or $V_{NC} = 1 \text{ V/2 V}$ , $V_{COM} = 2 \text{ V/1 V}$	Room Full	- 100 - 5000	5	100 5000	
COM Off Leakage Current <sup>g</sup>	I <sub>COM(off)</sub>	$V_{COM} = 1 \text{ V/2 V}, V_{NO} \text{ or } V_{NC} = 2 \text{ V/1 V}$	Room Full	- 100 - 5000	5	100 5000	pА
Channel-On Leakage Current <sup>g</sup>	I <sub>COM(on)</sub>	$V_{COM} = V_{NO}$ or $V_{NC} = 1 \text{ V/2 V}$	Room Full	- 200 - 10000	10	200 10000	
Digital Control							
Input Current	I <sub>INL</sub> or I <sub>INH</sub>		Full		1		μΑ
Dynamic Characteristics							
Turn-On Time	t <sub>ON</sub>	$V_{NO}$ or $V_{NC} = 1.5 \text{ V}$	Room Full		50	120 200	ns
Turn-Off Time	t <sub>OFF</sub>	v <sub>NO</sub> or v <sub>NC</sub> = 1.5 v	Room Full		20	50 120	113
Charge Injection <sup>d</sup>	Q <sub>INJ</sub>	$C_L = 1 \text{ nF, } V_{GEN} = 0 \text{ V, } R_{GEN} = 0 \Omega$	Room		1	5	рС
Off-Isolation	OIRR	$R_1 = 50 \Omega$ , $C_1 = 5 pF$ , $f = 1 MHz$	Room		- 74		dB
Crosstalk	X <sub>TALK</sub>	11 = 00 32, 0 = 0 p1, 1 = 1 Will 2	Room		- 90		] ub
NC and NO Capacitance	C <sub>S(off)</sub>	f = 1 MHz	Room		7		
Channel-On Capacitance	C <sub>COM(on)</sub>		Room		20		pF
COM-Off Capacitance	C <sub>COM(off)</sub>		Room		13		
Power Supply	. ,						
Positive Supply Range	V+			2.7		12	V
Power Supply Current	I+	$V+ = 3.3 \text{ V}, V_{IN} = 0 \text{ or } 3.3 \text{ V}$				1	μA

## Notes:

- a. Room = 25 °C, Full = as determined by the operating suffix.
- b. Typical values are for design aid only, not guaranteed nor subject to production testing.
- c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- d. Guarantee by design, nor subjected to production test.
- e.  $V_{IN}$  = input voltage to perform proper function.
- f. Difference of min and max values.
- g. Guaranteed by 5-V leakage tests, not production tested.



Parameter		Test Conditions Otherwise Unless Specified		D Suffix - 40 to 85°C			
	Symbol	$V+ = 5 V$ , $\pm 10 \%$ , $V_{IN} = 0.8 V$ or 2.4 $V^e$	Temp <sup>a</sup>	Min <sup>c</sup>	Typb	Max <sup>c</sup>	Unit
Analog Switch			1		- , , , _		
Analog Signal Range <sup>d</sup>	V <sub>ANALOG</sub>		Full	0		5	V
Drain-Source On-Resistance	r <sub>DS(on)</sub>	$V_{NO}$ or $V_{NC} = 3.5 \text{ V}, V_{+} = 4.5 \text{ V}$ $I_{COM} = 5 \text{ mA}$	Room Full		20	30 50	
r <sub>DS(on)</sub> Match <sup>d</sup>	$\Delta r_{DS(on)}$	$V_{NO}$ or $V_{NC} = 3.5 \text{ V}$	Room		0.4	2	Ω
r <sub>DS(on)</sub> Flatness <sup>d</sup>	r <sub>DS(on)</sub> Flatness	$V_{NO}$ or $V_{NC} = 1$ , 2 and 3 V	Room		2	6	
NO or NC Off Leakage Current <sup>g</sup>	I <sub>NO/NC(off)</sub>	$V_{NO}$ or $V_{NC}$ = 1 V/4 V, $V_{COM}$ = 4 V/1 V	Room Full	- 100 - 5000	10	100 5000	pA
COM Off Leakage Current	I <sub>COM(off)</sub>	$V_{COM} = 1 \text{ V/4 V}, V_{NO} \text{ or } V_{NC} = 4 \text{ V/1 V}$	Room Full	- 100 - 5000	10	100 5000	
Channel-On Leakage Current	I <sub>COM(on)</sub>	$V_{COM} = V_{NO} \text{ or } V_{NC} = 1 \text{ V/4 V}$	Room Full	- 200 - 10000		200 10000	
Digital Control							
Input Current	I <sub>INL</sub> or I <sub>INH</sub>		Full		1		μΑ
Dynamic Characteristics							
Turn-On Time	t <sub>ON</sub>	$V_{NO}$ or $V_{NC} = 3.0 \text{ V}$	Room Full		35	75 150	ns
Turn-Off Time	t <sub>OFF</sub>		Room Full		20	50 100	113
Charge Injection <sup>d</sup>	Q <sub>INJ</sub>	$C_L = 1 \text{ nF, } V_{GEN} = 0 \text{ V, } R_{GEN} = 0 \Omega$	Room		2	5	рC
Off-Isolation	OIRR	$R_1 = 50 \Omega$ , $C_1 = 5 pF$ , $f = 1 MHz$	Room		- 74		dB
Crosstalk	X <sub>TALK</sub>	11c = 30 32, 3c = 3 p1, 1 = 1 10112	Room		- 90		] "
NC and NO Capacitance	C <sub>(off)</sub>		Room		7		
Channel-On Capacitance	C <sub>D(on)</sub>	f = 1 MHz	Room		20		pF
COM-Off Capacitance	C <sub>D(off)</sub>		Room		13	_	
Power Supply							
Positive Supply Range	V+			2.7		12	V
Power Supply Current	l+	V+ = 5.5 V, V <sub>IN</sub> = 0 or 5.5 V				1	μA

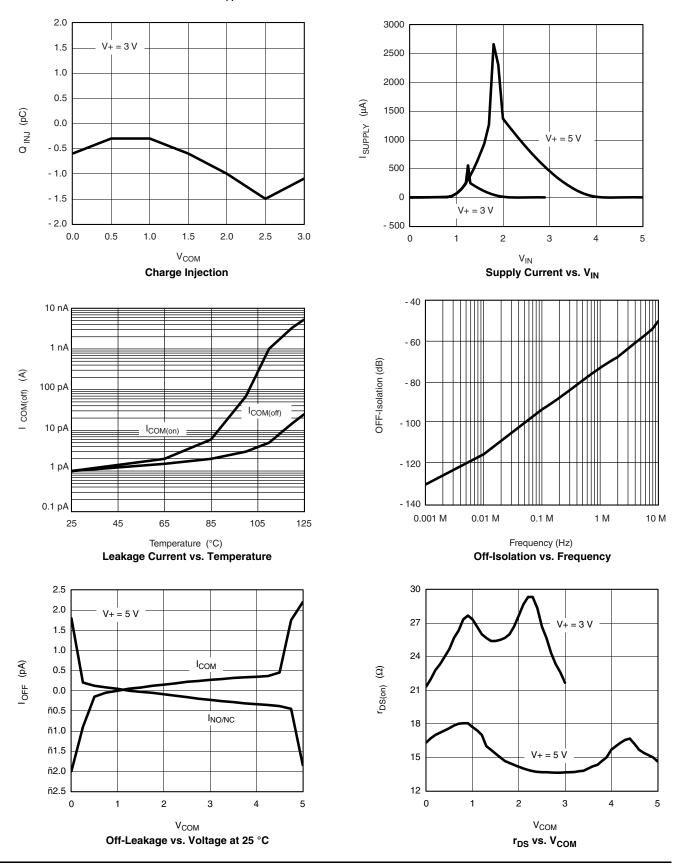
## Notes:

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- b. Typical values are for design aid only, not guaranteed nor subject to production testing.
  c. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- d. Guarantee by design, nor subjected to production test.
- e. V<sub>IN</sub> = input voltage to perform proper function.
- f. Difference of min and max values.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

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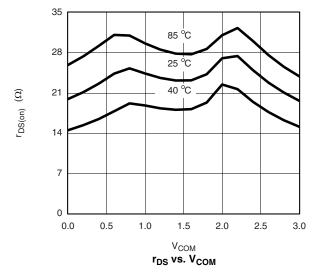
# **TYPICAL CHARACTERISTICS** $T_A = 25$ °C, unless otherwise noted

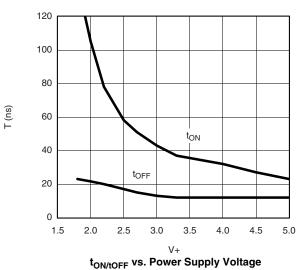


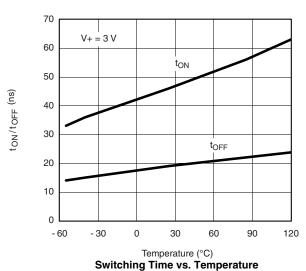


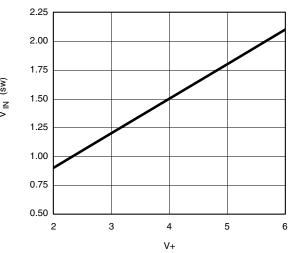


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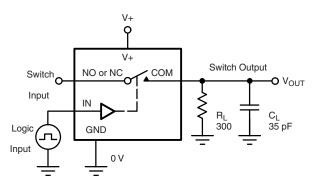




Input Switching Point vs. Power Supply Voltage

## **TEST CIRCUITS**





 $t_{\text{ON}}$ 

C<sub>L</sub> (includes fixture and stray capacitance)

$$V_{OUT} = V_{COM} \left( \frac{R_L}{R_L + R_{ON}} \right)$$

Logic "1" = Switch On Logic input waveforms inverted for switches that have the opposite logic sense.

Figure 1. Switching Time

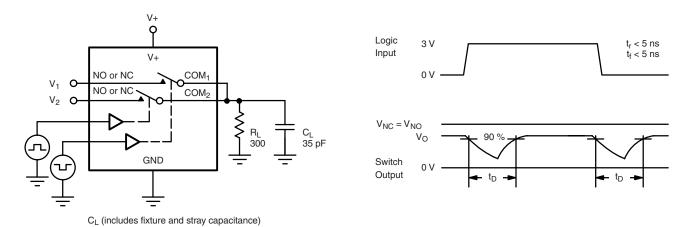
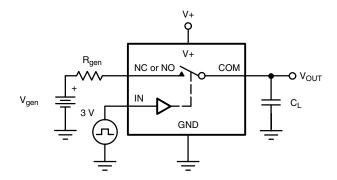
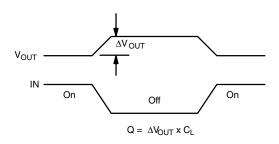


Figure 2. Break-Before-Make Interval





IN depends on switch configuration: input polarity determined by sense of switch.

Figure 3. Charge Injection



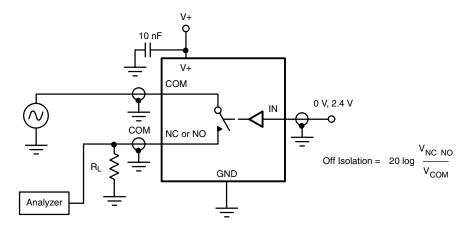


Figure 4. Off-Isolation

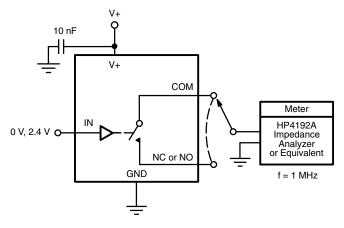


Figure 5. Channel Off/On Capacitance

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